

## § 20.1004

grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

NOTE: At very high doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts).

*Waste* means those low-level radioactive wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste means radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in paragraphs (2), (3), and (4) of the definition of Byproduct material set forth in this section.

*Week* means 7 consecutive days starting on Sunday.

*Weighting factor*  $w_T$ , for an organ or tissue (T) is the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of  $w_T$  are:

ORGAN DOSE WEIGHTING FACTORS

Organ or tissue	$w_T$
Gonads .....	0.25
Breast .....	0.15
Red bone marrow .....	0.12
Lung .....	0.12
Thyroid .....	0.03
Bone surfaces .....	0.03
Remainder .....	<sup>1</sup> 0.30
Whole Body .....	<sup>2</sup> 1.00

<sup>1</sup> 0.30 results from 0.06 for each of 5 "remainder" organs (excluding the skin and the lens of the eye) that receive the highest doses.

<sup>2</sup> For the purpose of weighting the external whole body dose (for adding it to the internal dose), a single weighting factor,  $w_T=1.0$ , has been specified. The use of other weighting factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued.

*Whole body* means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

*Working level* (WL) is any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate

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emission of  $1.3 \times 10^5$  MeV of potential alpha particle energy.

*Working level month* (WLM) means an exposure to 1 working level for 170 hours (2,000 working hours per year/12 months per year=approximately 170 hours per month).

*Year* means the period of time beginning in January used to determine compliance with the provisions of this part. The licensee may change the starting date of the year used to determine compliance by the licensee provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

[56 FR 23391, May 21, 1991, as amended at 57 FR 57878, Dec. 8, 1992; 58 FR 7736, Feb. 9, 1993; 60 FR 36043, July 13, 1995; 60 FR 48625, Sept. 20, 1995; 61 FR 65127, Dec. 10, 1996; 62 FR 4133, Jan. 29, 1997; 62 FR 39087, July 21, 1997; 63 FR 39481, July 23, 1998; 64 FR 54556, Oct. 7, 1999; 66 FR 55789, Nov. 2, 2001; 67 FR 16304, Apr. 5, 2002; 67 FR 20370, Apr. 24, 2002; 67 FR 62872, Oct. 9, 2002; 71 FR 65707, Nov. 8, 2006; 72 FR 55921, Oct. 1, 2007; 72 FR 68058, Dec. 4, 2007; 74 FR 62680, Dec. 1, 2009]

### § 20.1004 Units of radiation dose.

(a) *Definitions.* As used in this part, the units of radiation dose are:

*Gray* (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (100 rads).

*Rad* is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

*Rem* is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).

*Sievert* is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems).

(b) As used in this part, the quality factors for converting absorbed dose to dose equivalent are shown in table 1004(b).1.

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TABLE 1004(B).1—QUALITY FACTORS AND  
ABSORBED DOSE EQUIVALENCIES

Type of radiation	Quality factor	Absorbed dose equal to a unit dose equiva- lent <sup>a</sup>
	(Q)	
X-, gamma, or beta radiation .....	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge .....	20	0.05
Neutrons of unknown energy .....	10	0.1
High-energy protons .....	10	0.1

<sup>a</sup>Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.

(c) If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in rems per hour or sieverts per hour, as provided in paragraph (b) of this section, 1 rem (0.01 Sv) of neutron radiation of unknown energies may, for purposes of the regulations in this part, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee may use the fluence rate per unit dose equivalent or the appropriate Q value from table 1004(b).2 to convert a measured tissue dose in rads to dose equivalent in rems.

TABLE 1004(B).2—MEAN QUALITY FACTORS, Q,  
AND FLUENCE PER UNIT DOSE EQUIVALENT  
FOR MONOENERGETIC NEUTRONS

	Neutron en- ergy (MeV)	Quality factor <sup>a</sup> (Q)	Fluence per unit dose equiva- lent <sup>b</sup> (neutrons cm <sup>-2</sup> rem <sup>-1</sup> )
(thermal) .....	2.5×10 <sup>-8</sup>	2	980×10 <sup>6</sup>
	1×10 <sup>-7</sup>	2	980×10 <sup>6</sup>
	1×10 <sup>-6</sup>	2	810×10 <sup>6</sup>
	1×10 <sup>-5</sup>	2	810×10 <sup>6</sup>
	1×10 <sup>-4</sup>	2	840×10 <sup>6</sup>
	1×10 <sup>-3</sup>	2	980×10 <sup>6</sup>
	1×10 <sup>-2</sup>	2.5	1010×10 <sup>6</sup>
	1×10 <sup>-1</sup>	7.5	170×10 <sup>6</sup>
	5×10 <sup>-1</sup>	11	39×10 <sup>6</sup>
	1	11	27×10 <sup>6</sup>
	2.5	9	29×10 <sup>6</sup>
	5	8	23×10 <sup>6</sup>
	7	7	24×10 <sup>6</sup>
	10	6.5	24×10 <sup>6</sup>
	14	7.5	17×10 <sup>6</sup>
	20	8	16×10 <sup>6</sup>
	40	7	14×10 <sup>6</sup>
	60	5.5	16×10 <sup>6</sup>
	1×10 <sup>2</sup>	4	20×10 <sup>6</sup>
	2×10 <sup>2</sup>	3.5	19×10 <sup>6</sup>
	3×10 <sup>2</sup>	3.5	16×10 <sup>6</sup>

TABLE 1004(B).2—MEAN QUALITY FACTORS, Q,  
AND FLUENCE PER UNIT DOSE EQUIVALENT  
FOR MONOENERGETIC NEUTRONS—Continued

	Neutron en- ergy (MeV)	Quality factor <sup>a</sup> (Q)	Fluence per unit dose equiva- lent <sup>b</sup> (neutrons cm <sup>-2</sup> rem <sup>-1</sup> )
	4×10 <sup>2</sup>	3.5	14×10 <sup>6</sup>

<sup>a</sup>Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-cm diameter cylinder tissue-equivalent phantom.

<sup>b</sup>Monoenergetic neutrons incident normally on a 30-cm diameter cylinder tissue-equivalent phantom.

### § 20.1005 Units of radioactivity.

For the purposes of this part, activity is expressed in the special unit of curies (Ci) or in the SI unit of becquerels (Bq), or their multiples, or disintegrations (transformations) per unit of time.

(a) One becquerel = 1 disintegration per second (s<sup>-1</sup>).

(b) One curie = 3.7×10<sup>10</sup> disintegrations per second = 3.7×10<sup>10</sup> becquerels = 2.22×10<sup>12</sup> disintegrations per minute.

[56 FR 23391, May 21, 1991; 56 FR 61352, Dec. 3, 1991]

### § 20.1006 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by an officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

### § 20.1007 Communications.

Unless otherwise specified, communications or reports concerning the regulations in this part should be addressed to the Executive Director for Operations (EDO), and sent either by mail to the U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; by hand delivery to the NRC's offices at 11555 Rockville Pike, Rockville, Maryland; or, where practicable, by electronic submission, for example, via Electronic Information Exchange, or CD-ROM. Electronic submissions must be made in a manner that enables the NRC to receive, read, authenticate, distribute, and archive the submission, and process and retrieve it a single page at a time. Detailed guidance on making electronic submissions can be obtained by visiting the NRC's Web